Mercury is another constituent of concern and has been raised as an issue by the Band representative(s) for consideration in the EIS, primarily because many of the lakes and rivers in the area are classified as “impaired waters” by the MPCA because of elevated mercury in fish. Elevated mercury in fish is the result of increased availability of methylmercury, which could be caused by elevated inorganic mercury concentrations, and/or the increased efficiency of mercury methylation, which could be caused by a number of factors including enriched sulfate. The NorthMet Project area is located within the Lake Superior Basin, so it is subject to the Great Lakes Initiative mercury discharge standard of 1.3 ng/L. The NorthMet ore and waste rock contain trace amounts of mercury, but mass balance modeling and analog data from other natural lakes and mine pit lakes in northeastern Minnesota suggest that the mercury concentration in the West Pit Lake, the source of the only surface water discharge at the Mine Site, would stabilize at approximately 0.5 ng/L. There would also be mercury in the tailings, although about 92 percent of the mercury in the ore is predicted to remain in the ore concentrate and the mercury concentration in seepage from the Tailings Basin is expected to be less than the standard. Research by the MDNR has found that taconite tailings serve as a sink for mercury and a small-scale bench study found that mercury also adsorbs to NorthMet tailings, so the NorthMet Tailings Basin is expected to function as a sink for mercury. 5.2.2-3

Based upon results of Fond du Lac Band water quality monitoring, as well as additional resource investigations, the Reservation’s reach of the St. Louis River is attaining all of its beneficial uses and meeting all applicable water quality standards with the exception of mercury. In-stream mercury concentrations in the St. Louis River, measured by the Fond du Lac Band, have been below the Great Lakes Initiative Chronic Wildlife Standard of 1.3 ng/L, but exceed the Fond du Lac Band’s human health chronic standard of 0.77 ng/L. For this reason, the Fond du Lac Band is especially concerned about any new or expanded discharges to the St. Louis River upstream of the Reservation that may adversely affect mercury bioaccumulation in fish in the St. Louis River (Schuldt 2012). 5.2.2-14

The West Pit, like seepage/headwater lakes (e.g., lakes with no significant inflowing streams), receives most of its water from precipitation and direct runoff from the surrounding watershed. Water balance modeling estimates that 70 percent of the West Pit inflow after reclamation would be from precipitation. Therefore, natural seepage/headwater lakes and existing mine pits in the vicinity of the NorthMet Project area can provide an analog for mercury concentrations in the West Pit at the time of overflow. Data from 16 mine pit lakes and five natural headwater/seepage lakes in northeastern Minnesota were evaluated. As Table 5.2.2-48 shows, despite the fact that the primary source of inflow to these lakes/pits was precipitation, which averages 10 to 13 ng/L, only two of the lakes/pits had average total mercury concentrations above the Great Lakes standard of 1.3 ng/L (Pit 2W at 1.61 ng/L and Pit 9S at 1.87 ng/L). Regarding mercury, the Band representative(s) identified that all increases in mercury contributions to the environment constitute a risk to human and ecosystem health and are issues for consideration in the EIS.

Table 5.2.2-48 Total Mercury	**Number**	**Total Mercury Average Range**	**Individual Sample Range**	**Number wit Concentrati**

Concentration Data from Natural Lakes and Mine Pits in Northeastern Minnesota **Lakes/Pits**				
Natural Lakes	5	0.43 – 1.25 ng/L	0.34 – 1.73	0
Pit Lakes	21	0.4 – 1.87 ng/L	0.5 – 2.55	2

A mass balance approach was also used to evaluate potential mercury concentrations in the West Pit. The mass balance took into consideration average inflows and estimated potential mercury inputs from precipitation, atmospheric dry deposition, groundwater inflow, Category 1 Stockpile drainage, other stormwater runoff within the Mine Site, supplemental water from the Plant Site WWTP, collected seepage from the Tailings Basin, and inflows from the East Pit (Table 5.2.2-49). The mass balance also took into consideration the loss of mercury via burial (i.e., loss due to settling), evasion/volatilization, and outflow (i.e., pumping to the WWTF for treatment and discharge). The mass balance model conservatively assumes that mixing only occurs in the upper 30 ft of the water column, as this limits the volume of water available to dilute the mercury loading.

Based on the input values from Table 5.2.2-49 above, the estimated average mercury concentration of the West Pit during flooding (years 20 to 40) would be approximately 0.3 ng/L and after flooding (after year 40) would stabilize at approximately 0.5 ng/L.
It should be noted that the West Pit overflow would be treated by the WWTF using RO technology prior to discharge, and the RO process is known to remove mercury. Therefore, the actual mercury concentrations in the WWTF effluent discharge are expected to be less than the concentrations predicted for the West Pit lake i.e., less than 0.5 ng/L). Regarding mercury, the Band representative(s) identified that all increases in mercury contributions to the environment constitute a risk to human and ecosystem health and are issues for consideration in the EIS. Table 5.2.2-50 provides a summary of the initial mass balance results, with the largest input of mercury to the West Pit coming from atmospheric deposition (about 55 percent of total estimated inputs), and the largest loss of mercury attributed to burial (about 92 percent of total mercury inputs).

Direct Release of Mercury to the Embarrass River Watershed from the Tailings Basin
The Plant Site would receive inputs of mercury from two primary sources: residual trace concentrations in the tailings and process consumables, with some minor contributions from

Colby Lake makeup water and Mine Site process water, which would be pumped to the Tailing Basin pond through year 11. Mercury would be released from the Tailings Basin via seepage, discharge from the WWTP, and volatilization from the Tailings Basin pond (this mechanism is discussed in Section 5.2.7, Air Quality). As with the Mine Site, mercury was not included in the GoldSim model, but quasi-analog and mass balance approaches were used to estimate future mercury concentrations.
Several studies have been conducted by state agencies regarding the release of mercury from taconite ore processing and tailings facilities. Berndt (2003) concluded that wet and dry deposition of mercury were the major source of dissolved mercury in taconite tailings pond water, rather than the actual tailings themselves. Further, Berndt found that taconite tailings appear to be a sink for mercury in full-scale actual tailings basins in Northern Minnesota, as evidenced by lower mercury concentrations in waters seeping from tailings basins (specifically at U.S. Steel's Minntac Mine and Northshore Mining's Northshore Mine) than in either precipitation input or pond water in the tailings basin. This finding is supported by surface and groundwater monitoring around the existing LTVSMC Tailings Basin, which found mercury concentrations consistent with baseline levels (Table 4.1-31), generally averaging less than 2.0 ng/L. The overall average total mercury concentration at two discharge locations at the Tailings Basin (SD026 and SD004) over a 5-year period was 1.1 ng/L, indicating relatively low mercury concentrations in the existing LTVSMC tailings basin seepage. All monitoring results were well below average concentrations in precipitation, so most mercury appears to be sequestered in the LTVSMC tailings.
A mass balance model was developed to aid in estimating potential release of mercury from the Plant Site. All major inputs of mercury were included in the mass balance model. The major outputs of mercury include the hydrometallurgical residue, air emissions from the hydrometallurgical process, the tailings, and the ore concentrate. The vast majority of the mercury is predicted to remain in the concentrate, with only about 8 percent predicted to be sent to the Tailings Basin via the tailings and process water. Process and tailings water samples from a pilot study conducted with NorthMet ore were found to have mercury concentrations 11.2 and 0.7 ng/L, respectively. Mercury loadings to the Tailings Basin are estimated to be about 16 pounds per year (lbs/yr), with about 15.8 lbs/yr from solids and about 0.4 lbs/yr from process water. This is significantly less than the 610 lbs/yr estimated average mercury loading to the existing LTVSMC tailings basin during LTVSMC operations.
NTS (2006) conducted a bench study using NorthMet tailings to determine the rate of mercury adsorption by the tailings. The concentration of dissolved mercury in a treatment flask containing process water and NorthMet tailings decreased from 3.3 ng/L (at time 0) to 0.9 ng/L (at 480 minutes). Although the exact mechanisms behind the adsorption process is not yet clearly understood, the ability of NorthMet tailings to adsorb mercury, in combination with the proven ability of the underlying taconite tailings to adsorb mercury, is expected to result in an overall increase in the adsorption of mercury at the Tailings Basin with the addition of the flotation tailings.
In summary, the Tailings Basin is predicted to receive less mercury (about 2 to 3 percent) and less flow than the existing LTVSMC Tailings Basin historically received, while retaining the adsorption benefits of the LTVSMC tailings as well as the demonstrated mercury adsorption capability of the NorthMet tailings. For these reasons, it is reasonable to conclude that the seepage from the NorthMet tailings should have similar or lower mercury concentrations as the

LTVSMC tailings seepage, which have averaged about 1.1 ng/L. Therefore, the total mercury concentration in seepage from the Tailings Basin is expected to be less than the Great Lakes Initiative standard of 1.3 ng/L.

Most of the Tailings Basin seepage would be captured by the tailings containment system and pumped to the WWTP for treatment. The WWTP would also receive water from the Tailings Basin pond, as well as stormwater runoff from the basin. The discharge from the WWTP, like the discharge from the WWTF, would be subject to the Great Lakes Initiative standard of 1.3 ng/L. The estimated mercury concentration and flow rate for each of these influent streams is shown in Table 5.2.2-51. As this table shows, the combined influent streams are estimated to have a mercury concentration of 1.3 ng/L, prior to treatment.

In response to this policy, as well as to comply with sulfate standards that apply to waters supporting the production of wild rice, PolyMet has proposed several significant changes to the NorthMet Project design from that proposed in the DEIS that significantly reduce sulfate loadings, including a groundwater containment system around the Category 1 stockpile and a WWTF to treat the West Pit overflow at the Mine Site, and a groundwater containment system around most of the Tailings Basin and a WWTP to treat tailings seepage at the Plant Site. For the NorthMet Project Proposed Action, sulfate concentrations in receiving waters have been identified by the Band representative(s) as an issue for consideration in the EIS.

As a result of the design changes at the Mine Site, the project is predicted to increase the sulfate load by less than 2 percent in the Partridge River watershed, but maintain the same maximum P90 concentration (19.4 mg/L) as No Action (continuation of existing conditions) and a maximum P50 concentration of only 14.4 mg/L. Effluent from the WWTF would be discharged at 9 mg/L beginning when the West Pit is predicted to flood in year 40. Sulfate concentrations in this range would meet the state's definition of low-sulfate water and would not be expected to promote mercury methylation.

As a result of the design changes at the Plant Site, the Project is predicted to significantly decrease sulfate loadings to the wetlands north of the Tailings Basin and to the Embarrass River, primarily because the groundwater containment system captures nearly all Tailings Basin seepage and routes it ultimately to the WWTP, which treats the seepage and discharges the effluent at a target concentration of 10 mg/L as part of the tributary streams flow augmentation. The net effect of these engineering controls would be a reduction in sulfate loadings relative to No Action (continuation of existing conditions) model results at PM-13 (Figure 5.2.2-55).

Hydrologic Changes and Water Level Fluctuations

Methylation of environmental mercury by sulfate-reducing bacteria is also stimulated by drying and rewetting associated with hydrologic changes and water level fluctuations (Gilmour et al. 2004;

Selch et al. 2007). Drying (and subsequent increase in exposure to oxygen) of substrate containing reduced sulfur species (sulfides and organic sulfur) oxidizes those species into sulfate, which is remobilized and available to sulfate-reducing bacteria upon rewetting of the substrate. This mechanism stimulates production of methylmercury in sediments exposed to wetting and drying cycles (Gilmour et al. 2004) and probably accounts for some of the elevated methylmercury concentrations observed in discharge from wetlands during high flow events (Balogh et al. 2006). Thus, hydrologic changes and water level fluctuations can stimulate mercury methylation and enhance bioaccumulation.

As discussed previously, the NorthMet Project would have minor effects on flows in the Partridge or Embarrass rivers, or their tributaries, and would not be expected to result in increases in flow fluctuations that can promote mercury methylation.

Summary

Based on the above analysis, the NorthMet Project Proposed Action would have negligible effects on hydrologic changes or water level fluctuations in the Partridge and Embarrass watersheds, would maintain relatively low sulfate loadings and concentrations to the Partridge River, and would significantly reduce sulfate loadings to the Embarrass River. Overall, the NorthMet Project is not expected to increase the potential for mercury methylation either at the NorthMet Project area or downstream in the Partridge River, Embarrass River, or St. Louis River; in fact the project could be expected to reduce mercury methylation because of the overall significant reduction in sulfate loadings relative to existing conditions.